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In-situ Conservation of Plant Genetic Resources in Vietnam: Achievements and Lessons Learned

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I. Role of *in-situ* approach in the conservation of plant genetic resources in Vietnam

Genetic resources, among which plant genetic resources share a relevant contribution, are the most important of the whole biodiversity resources. Plant genetic resources play a determinant role of ensure the sustainable agricultural development, the sustainable food production and environment protection, that is why their conservation has been calling for an increasing attention.

There are two approaches of plant genetic resources conservation, the ex-situ and the in-situ. The *ex-situ* conservation, professionally is a synonym of the seed genebank, had principally developed in developed countries and CGIAR research centers in 1960's, 1970's and 1980's. *In-situ* conservation is beneficial in that it can maintain genetic resources in natural evolution. Only in-situ conservation can truly preserve the ecological system. Promoting in-situ conservation is the primal measure towards reestablishment of the lost biodiversity.

In situ conservation is concerned with maintaining species' populations in the natural habitats where they occur, whether as uncultivated plant communities or in farmers' fields as part of existing agro-ecosystems (Brush, 1995; Bellon *et al.*, 1997). *In situ* conservation of crop plants involves the conservation on-farm of local crop landraces with the active participation of farmers. The goal of *in situ* conservation is to encourage farmers to select and maintain local crop diversity for the benefit of humankind, at the same time benefiting from it for their livelihood needs. The objective of on-farm conservation may be diverse as diverse stakeholders are involved.

In situ conservation has the potential to

(1) conserve the processes of local adaptation of crops to their environments,

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(2) conserve diversity at all levels – the ecosystem, the species, and the genetic diversity within species,
(3) improve the livelihood for farmers,
(4) maintain or increase control and access of farmers over their genetic resources,
(5) integrate farmers into the national PGR system and involve farmers directly in value addition process, and
(6) link farming community to genebank for conservation and utilization.

The importance of conservation of agro-biodiversity for future of global food security lies in its potential to supply required germplasm to crop breeders and other users. On-farm conservation will provide public and private benefits (socio-economic, ecological and genetic benefits). However, in comparison with the ex-situ, the in-situ conservation is remarkably more complicated, not only for performance, but also for conducting research activities because it closely links with agricultural development tendency, mainly the market orientation. To conduct in practical the in-situ conservation plant genetic resources demands a lot of studies on both socio-economical and biological fields of sciences

As any developing country, Vietnam needs firstly to develop the ex-situ conservation to safely conserve the important and valuable, but actually severely eroding genetic resources. Paralleling to the ex-situ, have also developed the in-situ conservation in a strategy of safeguarding the genetic resources for food and agriculture in both aspects, inter-specific and intra-specific or genetic diversity.

II. Achievements on *in-situ* conservation of plant genetic resources in Vietnam in the past period

1. Forest genetic resources and wild relatives of crop genetic resources

Vietnam government has marked the boundaries of special used forests system in nationwide. Up to now, there are 102 special used forests that were established by government under control of Ministry of Agriculture and Rural Development. Based on IUCN classification system for reserve management, Vietnam classified the special used forests system as 4 levels the following:

Level 1: National Park
Level 2: Nature Reserve
Level 3: Species/ habitat management protected area
Level 4: Protected landscape or seascape

Forest genetic resources and wild relatives of crop genetic resources have been protecting management protected areas which were set up by the Government. Forestry tree genetic resources, wild relative plants and wildlife are being preserved and exploited at 12 National Parks, 72 Nature Reserves, Species/ habitat management protected areas, 18 Protected Landscapes and Seascapes (See the Appendix 1).

2. Projects on in-situ conservation of plant genetic resources in Vietnam:

-2-1. Strengthening scientific basis of in-situ conservation of agricultural biodiversity on-farm

The project was implemented during 1999-2003. The Project has the three main objectives:

1. To support the development of a framework of knowledge on farmer decision-making processes that influence *in situ* conservation of agricultural biodiversity
2. To strengthen national institutions for the planning and implementation of conservation programs for agricultural biodiversity, and
3. To broaden the use of agricultural biodiversity and the participation in its conservation by farming communities and other groups.

The partners of Project were Hanoi Agricultural University, Tay Nguyen University and Hue University, Cantho University and PGRC-VASI. The national project coordinator (NPC) was Director of VASI, with support from Plant Genetic Resource Center (PGRC). The following activities and achievements were obtained:

Crops and Site selection

Step1: Crops such as Rice, taro and cardamon were selected for the study. The major criteria for priority crop selection were native to East Asian Center of Origin, rich intra-specific diversity and importance to farming community. Site characterizations, diversity fairs, landrace characterizations, preference ranking of landraces and baseline survey were the major activities accomplished during the project period.

Based on the results of survey, balancing all the criteria and indicators and with those agro-biological, seven macrosites were selected:

Mountain: Da bac district of Hoa binh province and Sapa of Laocai
Highland: Nho quan district of Ninh binh province and Krongno of Daklac
Lowland, Red River Delta: Nghia hung district, Nam dinh province

Lowland, Mekong River Delta: Tra cu district, Tra vinh province
Lowland central coast: Phuvang of Thuathien-Hue

Site selection for *in situ* conservation: in Vietnam based on following criteria:

Environmental (natural and human managed) diversity
High species and intra-species diversity
High cultural diversity
Sustainability of on-farm conservation
Opportunity for improvement
Accessibility

The sites differ for several characteristics and represent the ecological zones and are most appropriate for the study Example: Tracu (Mekong delta; managed by Can Tho); Nghiahung (red river delta, lowland <1.5m; high yield potential, landraces are still maintained, traditional Kinh ethnicity); Nhoquan highland (60-90m; intermediate intervention; intermediate diversity of taro and rice) and Dabac (mountainous areas; 400-700 m; no intervention; high diversity of upland rice and taro crops)

Step 2: After finishing the selection of districts, which is called as "macro-sites", it forwarded to the selection of micro-sites or selection of communes within district and villages within commune. Selection of village is the basic step of the micro-site selection. The village in Vietnam is not only an administrative unit but traditionally also a unit of culture. Cultural features such as religion, tradition, custom, occupation... vary from one to the other village, but are usually homogenous within a determined one. Selection of village is mainly based on surveyed data in company with consultation of district and commune officers and utilization of existed statistical data play a very important role.

There are following microsites were selected:

- Tat village, Tanminh commune, and Cang village, Doanket commune, these two villages belong to Dabac district, Hoabinh province;
- Yenminh village, Yenquang commune, and Quangmao village, Thachbinh commune. These two villages belong to Nhoquan district, Ninhbinh province
- Donglac vilage, Nghialac commune and Kienthanh village, Nghialoi commune belong to Nghiahung district, NamdÞnh province.
- Tra kha and Rong lon villages, Daian commune belong to Tracu district, Travinh province.
- Bankhoang commune in Sapa district, Laocai province,
- Phuda commune in Phuvang district, Thuathien - Hue province,
- Krong No district, Daclac province

Farmer household selection:

Elemental unit on "cell" of the project has been conducted. To study biological and socio-economical aspects of agro-biodiversity on-farm conservation and approaches of it implementation based on the following indicators:

- Ethnic groups of the local community
- Culture and educational level
- Number of people in a household
- Number of laborers
- Areas of land, field, pond, home garden
- Income
- Self-supply of food
- Economic status.

In each village some household were randomly taken for survey of crop resources and socioeconomic: 10 % total of households were taken from small villages; then selected from 40 to 140 farmer households.

Training and scientific exchange:

- PRA training for rapid biodiversity assessment
-Training on approaches of assessment of agro biodiversity and household economy
- Training on computer and documentation
- Training data management, 25-29 May 1998
- Vietnamese scientists had been attended some training courses and workshops on technical assistance such as data management, GIS technique.... in international institutions.

Baseline survey and conduct implementing activities:

Carried out survey 112 indicators about socioeconomic, culture and education on 600 farmer households, these aim to

- Initial PRA survey for site selection and characterization
- Initial household baseline survey to understand farmers decision making processes that influence local crop diversity
- Preferred trait assessment study for adding value to landraces
- Community biodiversity register to monitor genetic erosion and develop alternative conservation strategy.

Diversity Fairs:

Successful fairs at project sites are Dabac, Nhoquan, Nghiahung, and Tracu districts with purposes which are to:

- Recognize farmers who maintain diversity
- Locate diversity and prepare inventory of crop genetic resources (CBR)
- Understand reasons of growing diverse genetic resources in terms of use, and economic, cultural, religious, breeding and ecological values, and
- Link *in situ* conservation with *ex situ* conservation.
- Enhance conservation through exchange

Methods:

- Planning meeting with LMDG
- Date and venue
- Display of crop diversity
- Locating diversity and custodians by PRA method
- Participatory identification of farmers' cultivars
- Preference matrix ranking to understand value of the farmers variety
- Community biodiversity register-monitoring genetic erosion

On-farm diversity blocks in rice and taro crops:

Locations: Nghiahung, Nhoquan, Dabac, and Tracu sites

With purposes are to public awareness, comparison of landrace collected in the diversity fairs for agro-morphological and performance evaluation; conservation by promoting exchange of landraces.

Inventory of crop species and assessment of agro biodiversity:

Using PRA tools and questionnaire throughout following periods

1964 - 1975	At record events war time
1976 - 1987	Post war economic reinforce
1988 - 1990	First period of economic renovation
1991 to date	Economic renovation

PPB and PVS at project sites:

- Development of farmer preferred crops and cultivars diversity
- Extending the local selected varieties into farming system
- To diversify crops and crop varieties in agricultural production:

New high yield and quality varieties of target crops are given to farmers in project site as introduced genetic resources. Diversification of upland rice, lowland rice, and taro varieties are adopted by trial and extending local varieties from other areas of Vietnam.

Establishment conserved pilots at project sites:

Establish models for on-farm conservation at farmer household level for rice and taro crops in project sites; this aim to identify crop composition and to establish genetic conservation methods.

-2-2. The contribution of home gardens to *in-situ* conservation of plant genetic resources in farming systems

Home gardens hold a singular place in the culture of the Vietnamese people, and reflect their pride in their ancient tradition of gardening. The cultural value attached to home gardens has been reinforced by their important contribution to household food security in the rural, especially in the remote areas. Since 1999-2001, IPGRI's project is studying home gardens in 5 sites around the world including Vietnam. The IPGRI agreed and signed with VASI in collaborating to undertake the project "*The contribution of home gardens to in-situ conservation of plant genetic resources in farming systems*". The project located 4 sites in Vietnam.

The project has three objectives:

1. to document the species and intra-specific diversity in home gardens and the biological, cultural and socio-cultural factors that governs its distribution and supports its maintenance.
2. to development methods and approaches for including for home garden systems as components of national programs for *in situ* conservation of agro-biodiversity.
3. to support the development of "conservation through use" strategies in national plant genetic resources programs as a complement to crop based *in-situ* and ex-situ conservation.

Project's activities and achievements in Vietnam

Selection of macrosite to implement the project

Vietnam has seven agro-ecosystems. It was planned to implement the project in four of them, those are one in the north, one in central, one in eastern south and one in western south. Criteria of site selection were developed which includes:

- Diverse agro-ecosystems, in terms of species and genetic diversity as well as horizontal and vertical heterogeneity

- Cultural and socioeconomic diversity
- Importance of home gardens for livelihoods and community
- Perceived threat to traditional structure and composition of home gardens due to market forces and/or policy changes
- Existence of indigenous knowledge, skills and traditions in managing home garden system
- Community interest and cooperation
- Capacity of local research institutions
- Accessibility

The criteria used in Vietnam are designed to capture the range of socio-economic, cultural and agro-ecological variability within the country. Four sites were chosen which reflect variations in demography and ethnicity, access to markets, distance from natural ecosystems, and environmental limitations (water availability, soil fertility, etc.).

Nhoquan in Ninhbinh province was chosen as a site for northern Vietnam. The area of home garden is small and they are cultivated intensively. In Nhoquan, however, as in most places in Vietnam, the continuity of the home garden tradition was broken by war, and only rarely does one find a home garden more than 30-40 years old today.

The Nghiadan in Nghean province site is representative of the ecozone of north-central Vietnam. Its climate differs from that of the Nhoquan: Winter is the same, but summer is influenced by hot, dry winds from Laos. It is the home gardens site highest in elevation, in the midlands of Vietnam, providing both a cultural and economic contrast to the other sites.

The district of Thuanan in Binhduong province is located in the Eastern-South Basin, with a typically tropical climate with high temperatures year-round.

The district Chauthanh in Cantho province is representative of the Western-South Basin, currently called the Mekong Delta. It is a canal-based community located in the heart of the Mekong Delta.

Baseline survey and conduct implementing activities

A checklist questionnaire was carried out in November-December 1998 for up to 60 households at each site. All socioeconomic data were collected which concerned about

- Home garden size,
- Diversity,
- Household demographics,
- Age of home garden.

Key informants in the village (such as the headman) were used to select households with the most diversity and knowledge of gardening in order to provide a sample of the processes,

interaction, and uses of plants in home garden management. Eventually, 30-35 households representing home gardens in their communities were selected for a more in-depth household survey.

A baseline survey containing information on land use, home garden area, number of species grown, household ethnicity, education, yearly household income breakdown, labor and capital investment in HG per year was carried out through 1999.

A second survey entitled "*Crop species and their varieties cultivated in HG*" was completed in 2000, in which species were classified into five groups according to ecological structure and stories within the garden (Roots and Tubers, Shrubs and Climbers, etc).

An inventory of PGR was compiled from the survey with supplemental information in farmer interviews. The survey focused on uses of HG plants, sources of germplasm, commercialization and also included a distribution and transect map of the household.

A third survey focused on gathering ethno-botanical knowledge of using genetic diversity and seed flow of four key species, on farmer group discussion concerning predominant gardening aspects of top ten crop species was carried out in March-April 2001.

Base on the surveyed data, some issues were conducted:

1. Assessment and documentation of indigenous knowledge in using of local genetic diversity.
2. Study on dynamic processes of PGR evolution under HG management for establishing proper strategies of genetic diversity conservation and development.
3. Study on socio-economic aspects of gardening with emphasis on the link between HG and livelihood and gender dimension.
4. Contribution to HG diversity and adding value through PPB/PVS

Inventory crop species in Vietnamese home gardens

Followings are main results of survey and previous results of survey data analysis. A general characterization of plant genetic diversity found in home gardens of each of four selected eco-sites is presented below.

Site name	Ecological features	Avg. no of species per HG	Range of species per eco-site	Avg. garden size (m^2)	Avg. no of species/ (100 m^2)
Nhoquan	North: midland, subtropical to temperate	38,6	27-54	1407,9	2.7417
Nghiadan	North central midlands, tropical and subtropical	23,4	12-42	2771,7	0.8442
Thuanan	Eastern-South: lowland, typical tropical	50,3	36-78	2822,9	1.7819
Chauthanh	Mekong Delta: lowland, typical tropical	53,9	20-103	7500	0.7187

Research on key species.

From the 2nd year of project implementation, key species cultivated in home gardens of Vietnam had been studied. Selection of key species was based on the following six criteria:

- Widely distribution in HG throughout the country,
- Endemicness,
- Genetic diversity,
- Importance and sustainability on farmer household livelihood.
- Strong cultural connection and probability it will be maintained,
- Having a wide using way.

Four crops representative to all plants cultivated in Vietnam home gardens were selected as key species: Banana, Pomelo, Taro and Tania, and Luffa.

Gender survey and analysis

Different gender may put different values on genetic resources and their environmental function. The gender division of resources, knowledge, work and product may reflect conflict, complementary or coincidence of men and women's interest in land use systems.

Preliminary results show that men make most decision relating to cultivation of fruits and ornamentals. Fruit trees tend to generate the greatest income for the family and are highly commercialized. Ornamental plants are mostly for entertainment and need some sorts of art, which are likely to be the works of men.

In contrast, spices, medicinal, root and tuber crops seem to be the work domain of women. These crop species, in no doubt, are most important for home consumption and seem to be closely related to daily meal preparation works of women. In addition, women are responsible for the health of the whole family, therefore, they collect, plant and use of medicinal plants in home garden.

-2-3. *In situ* conservation of local rice varieties

In 1996, Agriculture and Forestry University in Central Vietnam (Hue City) started a collaborative project on *in-situ* conservation of local rice varieties with financial and technical assistance of IRRI. This is part of the Vietnam - IRRI Project "Safeguarding the preservation of the rice genepool" coordinated by the Plant Genetic Resources Center, VASI.

-2-4. Community based pilot project for the management of plant genetic resources in Vietnam

Management and conservation of biodiversity can be sustainable and effective only when the best value plant genetic resources (PGR) can be used to meet the local communities' demands, hence contributing to common benefit of all people and the state. Vietnam Agricultural Science Institute (VASI) has implemented the project "Community based on farm management of plant genetic resources" in collaboration with CIC and funding by the Italian Minister of Foreign Affairs. The project activities are being carried out in 3 different eco-sites in North Vietnam, namely the Dong Lac village, Nghia Lac Commune, Nghia Hung District of Nam Dinh province, representative for the Red River Delta; the Phu Son Commune of Nho Quan District of Ninh Binh provinces, representative for the Northern midlands, and the Chieng pan Commune, Yen Chau District of Son La Province, representative for the Northern mountainous regions of Vietnam.

The Phase 1 carried out from 1994 to 1995, surveyed the agro-biodiversity in the North of Vietnam.

In the 3 years period of Phase 2 since 2001 to 2004, the project objectives of this phase aims to restoration of biodiversity as a tool for environment protection in different agro-ecological conditions with different target species. Diversification of species existing in cropping systems of farmers' households as well as diversification of cropping ecological systems is also the concrete objectives of the project. Through creation of conditions for farmers to get access to traditional and local indigenous crops species and assisting them to know the value of these species can involve the farmers' participation in conservation and utilization of these low-cost PGR, but beneficial to local communities. Promoting community participation was main objectives of Project. Providing the stability and increasing income for the participating communities' households will serve as basis for *in-situ* conservation and increase of PGR and wild relatives of crops in farmers' communities.

Activities and achievements of the project:

- Survey of natural and climate condition at three project sites: Nghia Hung, Nho Quan, Yen Chau
- Survey the distribution and genetic diversity of the target crops at each ecosites, such as in Nghia Hung site: Traditional aromatic rice groups named “Tam thom”; In Nho Quan site: Longan, Persimmon, Mango and a local species of fruit crop named “Thanh Tra” (*Bouea oppositifolia*); In Yen Chau site with high diversity of mango species. Based on survey data, we determined existing 5 mango species in Yen Chau valley. From data, three local varieties with unique qualities were selected as the main target crops: the mango of Yen Chau District, the Kaki of Nho Quan District, and the aromatic rice of Nghia Hung District.
- In order to make three these local germplasm competitive with HYV in terms of income generated to the farmers, the following tasks were done:
    + To collect, identify, and multiply local varieties in danger of extinction in order to have it available for reintroduction in the farming system;
    + To develop low external inputs based agronomic practices for locally adapted farmers’ varieties for reducing cost of production
    + To promote local products in the internal market through campaign for raising awareness and registration of Protected Geographic Indication (PGI
- Introduction of modern propagation methods for fruit crop (especially of grafting); the cultivated protocol of aromatic rice “Tam thom” combined the traditional indigenous knowledge and modern approaches.
- Creation of an the Experimental-catalogue Field (Nursery Community) at three project sites
- Supplying Longan, Persimmon, Mango rootstocks from Nursery Community to farmers. Collecting Mango samples (including flowers, buds, leaves and fruits) for classification and for DNA extraction.

-2-5. On farm conservation of plant genetic resources at community, Can Tho University in collaboration with CEARICE

The project has been started since 1991 which conserve and develop rice genetic resources in Me Kong river delta. Objectives of the project are the following:

- To collect local rice germplasm before they disappeared by modernization policy of rice crop cultivation at Me Kong River Delta
- To take the initiative of conservation and development of rice genetic resource thanks to farmer community
- To strengthen Rice Genebank of Can Tho University in three years to be equal to the most important rice Genebank in Me Kong River Delta.

After three years, there are 1,000 samples of local rice varieties were collected. This collection was eliminated the duplicate samples remaining 812 varieties, they are being conserved in Can Tho University Genebank and evaluation as well. Beside the conservation activities, the project distributed varieties to farmer communities, 517 varieties were supplied to farmers which will be cultivated in adaptable condition and evaluated by farmers. The second phase of the project concentrated studying 6 objectives: Diversity of plant genetic resources; Conservation of PGR; Development of PGR; Seed supply system; Traditional knowledge and Policy.

-2-6. *In-situ* conservation of native landraces and their wild relative in Vietnam - VIE/01/G35

The project *In situ* Conservation of Native Landraces and their Wild Relatives in Vietnam (VIE/01/G35) which was managed by Ministry of Agriculture and Rural Development (MARD) and conducted by Institute of Agricultural Genetics (IAG), was implemented at 8 project sites in Vietnam over a period from May, 2002 to December, 2005. The project received technical advices from International Plant Genetic Resources Institute (IPGRI), was sponsored by Global Environment Fund (GEF), United Nation Development Program (UNDP), and Vietnamese Government. The aim of the project was to *in situ* preserve genetic resources of species in 6 native landraces i.e. rice, ricebean, citrus (orange, manderine, pomelo), tea, taro, and longan-lychi, and their wild relatives in 7 Northern provinces of Vietnam (Caobang, Hagiang, Tuyenquang, Langson, Hatay, Hungyen, and Haiduong). These provinces have a high level of diversity of the above native landraces and their wild relatives. They are, therefore, ideal areas for the *in situ* conservation program. To reach its target, the project has implemented a policy encouraging and creating favorable conditions for the construction of sustainable Plant Genetic Resources Importance Zones (PGR-IZs) with the involvement of communities. The project also aimed at improving education status and social perception of the community, and at propagating information relating to the expansion of genetic management zones (GMZs).

The project used community participatory methods and took every chance to obtain positive contributions of the communities to the conservation program. The specific methods are: organizing training courses, seminars, field trips, producing publications, video, pictures ect… to provide knowledge and to improve the perception of the communities on conservation. In addition, the project conducted surveys and studies on natural, economical, and social situations of the conservation zones to create scientific databases for the development of a long term conservation program. Furthermore, the project used information techniques - Geographic Information System (GIS) - to build PGR-IZs and supervise the diversity of the concerned species.

Four active components of the project: (i). Setting up Plant Genetic Resources Importance Zones through the establishment of suitable and encourageous environment; (ii) Creating favorable conditions for the operation of PGRIZs through removing obstacles and training to improve the capacity of human resources; (iii) Conducting specialized researches, analyzing and managing information to support the establishment and operation of PGR-IZs; and (iv) Improving perception capability of communities through education and propagating information to support the expansion of PGR-IZs. After 3-year operation, the project has achieved the followings:

-Ten PGR-IZs has been established. Native landraces belonging to the 6 target plant species and their wild relatives has initially been safely conserved at dynamic agro-forestry zones.

-The diversity of plant species of priority found existing in each PGR-IZ has been documented.

-Awareness in local communities on conservation has been improved and;

-Efforts of local communities in conservation and effective utilization of biodiversity has been enhanced. Eleven community participatory models of conservation which are expandable to other regions have been established.

The National Coordinating Committee of the project, in conjunction with Institute of Agricultural Genetics published a book titled: "*In situ* Conservation and Sustainable Use of Native Landraces and their Wild Relatives in Vietnam" with the aim to provide researchers in research institutions with information relating to *in situ* conservation approaches of agricultural biodiversity for sustainable agricultural production and national food security.

III. Lessons Learnt

1. What basic information needed to understand *in situ* conservation?

Following four main research questions will be providing a scientific basis for designing and planning effective *in situ* (on-farm) conservation:

1. what is the extent and distribution of the genetic diversity maintained by farmers over space and over time,
2. what are the processes used to maintain the genetic diversity on-farm,
3. who maintains genetic diversity within farming communities (men, women, young, old, rich, poor, certain ethnic groups), and
4. What factors (market, non-market, social, environmental) influence farmer decisions on maintaining traditional varieties.

Answering these four research questions together with strengthening formal and informal capacity and links has enable national programme to support farmers in the conservation and use of crop genetic resources through enhancing the social, economic, ecological and genetic benefits from local crop resources to farmers and other stakeholders.

2. Promoting in-situ genetic resources conservation together with agro-forestry ecological system conservation

Promote research on evaluation and exploitation of germplasm.

Conservation through use can only be feasible when genetic resources are in mass use. Therefore, Vietnam needs to invest on scientific research on germplasm evaluation and exploitation. The main content of this is to evaluate genetic diversity to identify and to detect valuable gene sources. Evaluation of genetic diversity needs the implementing research from molecular and agro-morphological levels to ecological adaptation. From the evaluation, good plant varieties and animal races can be selected to extend in production.

Diversity gene pool in agro-forestry production.

This is the most important measure to realize conservation through use of genetic resources, particularly for crop species. Diversifying crop gene pool in production includes diversifying crops, diversifying varieties of each crop and diversifying genes in each new breeding variety. This work is to promote sustainability of production and efficiency in agricultural environmental protection. Diversifying gene pool in production needs to be made through detailed agro-promotion missions in the national agriculture extension policy.

Major steps of in-situ conservation for each target germplasm:

1. Survey and study to identify germplasm need to be conserved, study natural, socioeconomic conditions at selected eco-zones.
2. Boundary and establishment of pilots for in-situ conservation of target crops, races, species
3. Observation of changes, evaluation of effectiveness
4. Establishment of germplasm management information system aim to exchange and monitoring
5. Increasing the indicators of richness and evenness by germplasm diversity, combination of conservation and utilization, and effective introduction of traditional germplasm.

3. Summing up orientation a strategy on in-situ conservation of plant genetic resources can be classified to the following three groups:

1. Forest plant species, wild relative plants and wildlife should be conserved at special used forests such as national parks and nature reserves.
2. Wild relative plants not in existence in the special used forests. Up to certain case, of in-situ conservation spot is set up for each species or group of species.
3. Perennial crop species, mainly fruit and cash crops, establish conservation areas in different ecological areas throughout the country which located in Vinh Phuc (Phu Ho) and Baria Vung Tau (Tan Thanh) provinces for fruit crops; Dak Lak (Buon Ma Thuat) and Nghe An (Phu Quy) provinces for cash crops.
4. Annual food crops include calorie crops and others food crops use on-farm conservation.

IV. Conclusion

Plant genetic resources play a determinant role of ensure the sustainable agricultural development, the sustainable food production and environment protection, that is why their conservation has been calling for an increasing attention.

There are two approaches of plant genetic resources conservation, the ex-situ and the in-situ. In-situ conservation is beneficial in that it can maintain genetic resources in natural

evolution. Only *in-situ* conservation can truly preserve the ecological system. Promoting *in-situ* conservation is the primal measure towards reestablishment of the lost biodiversity.

The goal of *in situ* conservation is to encourage farmers to select and maintain local crop diversity for the benefit of humankind, at the same time benefiting from it for their livelihood needs.

Diversifying gene pool in production needs to be made through detailed agro-promotion missions in the national agriculture extension policy. Exchange the germplasm is necessary to enrich the gene pool.

Major challenges are (i) to integrate the conservation of plant genetic resources with agricultural development, and in particular to conserve as much diversity as possible and the processes that give birth to it; (ii) to develop the framework of knowledge to determine where, when and how *in situ* conservation will be effective and develop a broad guideline for research and practice *in situ* conservation for national programmes that address the needs of farming community as well.

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